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COMMAND VERSUS CONTROL IN THE AGE OF INFORMATION TECHNOLOGY

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ABSTRACT

The enormous advances in Information Technology over recent decades represent a significant milestone in the development of Command and Control. While advances in Information Technology are mostly driven by commercial developments rather than by classified military research, some of the available Control systems assist to a certain degree the Control process, but not necessarily the commander. Therefore, new Control systems should be examined prior to their implementation for their impact on the basic dimensions of Command.

Based on a decision tree offered by McCann and Pigeau and using an analysis of the test results of the Austrian Armed Forces the paper considers the impact of HEROS, a new Control system, on Command at the operational level. The examination begins with a short description of the three basic dimensions of Command, the relationship between Command and Control, and some essential information about the development of HEROS as part of the future Command and Control system of the Austrian Armed Forces. Further, the impact of HEROS on the fundamental dimensions of Command, as defined by McCann and Pigeau, is analyzed and some assumptions concerning further development and implementation of the subject Control system are outlined.

The paper concludes that modern Control systems like HEROS support only some of the basic dimensions of Command in war, are neutral to many others and can even have negative impacts on some of the dimensions.

"A good C^3 I ... system has to be able to degrade gracefully; that is,
it must be able to lose some of the capability that it started with initially,
and still not come unglued ... As we concentrate ... on how best to design the C^3 I
system, there's a tendency to envision one that's centralized –
but frequently centralized systems don't degrade gracefully."

Thomas H. McMullen (1982),
quoted in *C^3 I*: Issues of Command and Control

INTRODUCTION

The problem of Command and Control of military forces is as old as war itself. Early armies had to establish decentralized Command and Control systems because of their lack of capability to communicate quickly and efficiently with subordinate commanders. Frederick the Great was one of the first commanders to establish a centralized Command and Control system. His highly disciplined units were able to move effectively in an assigned direction but they were not used to dealing with unplanned and surprising situations. On such occasions it was the Prussian cavalry, often acting on its commanders' own initiative, without orders from the king, which saved the day. [1]

Over the last few decades enormous advances in Information Technology have enabled the development of highly sophisticated military Command and

[1] Martin van Creveld, Command in War, Cambridge, Mass: Harvard University Press, 1985, p. 55.

Control systems. Pushed by advances in the civilian sector, the rate of development and integration of Information Technology into military organizations is not likely to diminish. The decreasing costs both of hardware and software make it possible to extend these capabilities to all operational and tactical echelons. All main functions can be served by and depend on this technology. However, Information Technology is mostly driven by commercial developments rather than by classified military research. Therefore, many developed Command and Control systems primarily assist the Control process and not the commander. This has resulted, in some cases, in ineffective systems, which can even jeopardise Command.[2]

The Austrian Armed Forces have purchased Information Technology in the past as part of its Command and Control system; however, these systems often do not undergo any rigorous evaluation process to determine how they will serve the decision makers.[3]

The emphasis now being placed on the human factors of Command, does not ignore technology, but stresses that technology must be responsive to human needs. Therefore, it is important that all changes to the Control process are assessed for their impacts on Command before implementation.

Using the methodology of Carol McCann and Ross Pigeau, this paper will consider the impact of HEROS, a new Control system, on Command at the operational level in the Austrian Armed Forces. The examination begins with a

[2] Carol McCann and Ross Pigeau, "Putting Command back into Command and Control", Defence and Civil Institute of Environmental Medicine, Toronto, 1995, p. 10.
[3] Interview: Bgdr Mather, BMLV/ITPlan, 27 Sep 01.

short description of the three basic dimensions of Command, the relationship between Command and Control, and some essential information about the development of HEROS as part of the future Command and Control system of the Austrian Armed Forces. Based on the results of two test series, the impact of HEROS on the fundamental dimensions of Command, as defined by McCann and Pigeau, will be analyzed and some assumptions concerning further development and implementation of the subject Control system will be outlined.

As a result of this analysis it will be concluded that modern Control systems like HEROS support only some of the basic dimensions of Command in war, are neutral to many others and can even have negative impacts on some of the dimensions.

COMMAND AND CONTROL AT THE OPERATIONAL LEVEL

There are a number of key characteristics at the operational level of war and their relative importance will vary from campaign to campaign. Military activity at this level is likely to be influenced both by overarching political considerations and subsequent changes in policy guidance. Military actions can be politically self-defeating and negatively affect the achievement of political objectives.

The operational commander is required to plan and orchestrate all military activities to achieve these objectives. The freedom of action delegated to him will depend on the nature of the conflict and the extent to which national interests are threatened.

The operational level is by definition joint and the vital interplay between the services involved must be recognized as a main focus.

While the requirements for decision-making at the operational level are very high, there is a need for a sophisticated Control system, which supports Command in war.

Greg Foster has described the state of Command and Control theory as bleak, diffuse, and seemingly random. [4] Many of the definitions in military documents are descriptive and lacking of conceptual guidance. Recently the Canadian scientists McCann and Pigeau established a new theoretical basis for Command and Control.[5] The following part gives a short overview on this new approach in comparison with the official Canadian Forces definitions.

COMMAND

The official definition of the Canadian Forces is as follows: *Command – The authority vested in an individual of the armed forces for the direction, coordination, and Control of military forces*. [6]

McCann and Pigeau defined Command in a different way: *The creative expression of human will necessary to accomplish a mission.* [7]

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[4] G.D. Foster, "Contemporary C2 Theory and Research: The Failed Quest for Philosophy of Command," *Defense Analysis 4*, no. 3, 1988, p 213.
[5] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999.
[6] Canadian Forces Operations, B-GG-005-004/AF-000, dated 02 Oct 2000, p. 2-1.
[7] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999, p: 5.

This definition highlights the factor human will as an important component of Command, which provides, among other things, the initial conditions to start and sustain Control. Command, as it is independent from rank and echelon, is an inherent human activity. Therefore, soldiers of all ranks can easily meet the requirements of the subject definition. [8] If every soldier has the potential as mentioned above, what differentiates the capability of Command?

McCann and Pigeau argue that there are three dimensions of Command, which set the general officer apart from the private, namely competency, authority and responsibility.

COMPETENCY

Intellectual competency is an essential skill for decision makers especially "for planning missions, monitoring the situation, reasoning, making inferences, visualizing the problem space, assessing risk and making judgements". [9] It requires creativity, flexibility and the will to learn continuously.

The difficult work environment and the disruptive impact of deployments to family life and stability requires *emotional competency,* strongly associated with hardiness, resilience and the ability to work under stress. To be able to keep an overall emotional balance and a perspective on the situation is another critical skill.[10]

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[8] BGen (retired) G.E. Sharpe and Allan English, "Principles for Change in the post-cold War Command and Control of the Canadian Forces", 28 Jun 2001, unpublished paper, p 50.
[9] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999, p: 7.
[10] Ibid: p: 7.

The ability to deal tactfully with civilians, soldiers of all ranks of different armies and cultures, even in difficult situations, requires a highly developed *interpersonal competency* based on social skills. Finally, physical strength, health, agility, and endurance are important for all kinds of operational tasks. Therefore, *physical competency* is fundamental for all militaries even at the operational level.

AUTHORITY

"Authority refers to the domain of influence of Command. It is the degree to which one is empowered to act, the scope of this power and the resources available for enacting will." [11] McCann and Pigeau distinguish between two types of authority. *Legal authority,* defined as the power to act that is assigned by the government, which includes the power over personnel and resources as well as the power to act. The second type is *personal authority*, which is the authority informally given by peers and subordinates. It must be earned over time based on reputation, experience and character. [12]

RESPONSIBILITY

The final dimension of Command is the ability to take responsibility for personnel, resources and decisions. It stands for the degree to which an individual accepts the moral liability and obligation to Command. There are two types of responsibility, one externally imposed and the other, which is internally generated.

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[11] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, unpublished paper, copy available from author, p: 6.
[12] Ibid: p. 6.

The first one is called *extrinsic responsibility* and involves public accountability. "(It) is the willingness to be held accountable to external agencies or people for authorities given (both legal and personal)." [13] *Intrinsic responsibility,* the second one, relates to self-generated obligations and is a function of the resolve and motivation of the individual. This component is the most difficult to achieve. [14]

CONTROL

Control within the Canadian Forces is defined as: ... – *That authority exercised by a commander over part of the activities of subordinate organizations, or other organizations not normally under his Command, which encompasses the responsibility for implementing orders or directions. All or part of it may be transferred or delegated. ...*[15]

In contrast to this, McCann and Pigeau define Control as: *Those structures and processes devised by Command to manage risk.* [16]

This definition contains three major aspects. The basic function of Control is to manage risk, mainly associated with the fog of uncertainty around military operations. Control manages risk through the application of structures and processes. The third important aspect is that Control structures and processes are tools of Command.

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[13] Ibid: p.13.
[14] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999, p: 9.
[15] Canadian Forces Operations, B-GG-005-004/AF-000, dated 02 Oct 2000, p. 2-2.
[16] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999, p: 4.

Structures are frameworks of interrelated concepts that define and classify some things. Military structures for example consist of a host of Control structures like order of battle, databases, chain of Command etc. Control processes are sets of regulated procedures that allow Command structures to perform work. [17]

Control structures and Control processes are different in their degree of formality and rigidity, ranging from very high - e.g. equipment, software – through plans and Rules of Engagement to the lower degree – e.g. organizational structure and doctrine. The purpose of Control is to affect the will of Command by making use of structures and processes to reduce uncertainty and to manage risks, which jeopardise the accomplishment of missions. The two main sources of uncertainty are the physical environment and the actions of individuals, both friendly and adversary. These factors can be reduced by effective Control but never completely eliminated. Control accomplishes risk management through the careful application of structures and processes. An appropriate Control system has to coordinate available resources in a systematic way, with careful checks and balances, in order to reduce the uncertainty to the lowest possible degree.

As mentioned earlier, the key aspect of the definition, offered by McCann and Pigeau, is that Control is devised through Command. Having this in mind, the following section will examine Command and Control and their interrelationship.

[17] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999, p: 3.

COMMAND VERSUS CONTROL

Recently a new definition of Command and Control (C^2) has been established by McCann and Pigeau: *C^2 is the establishment of common intent to achieve coordinated action.* [18]

Common intent and coordinated action are essential for military operations. They argue that there are two types of intent. The first one is *explicit intent*, that part which has been issued through orders, briefings, back-briefings and questions, shared by the commander and subordinates prior to, or during, an operation. On the other hand, explicit intent carries automatically a network of expectations and connotations, the *implicit intent*. It has its origin in personal expectations, training, education, tradition, ethos and cultural values. Implicit intent has been developed over a long period, even years, prior to the operation. [19]

The new definition, mentioned above, allows for two kinds of organizational structures. McCann and Pigeau argue, that a high proportion of shared explicit intent in a C^2 organization compared to the amount of shared implicit intent, indicates centralized C^2. In those structures subordinates are explicitly told not only what they have to achieve, but how to do it. It is an inherent disadvantage of centralized organizations that, in case of quickly changing situations, the decision

[18] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999, p: 2.
[19] Carol McCann and Ross Pigeau, "Re-defining Command and Control", Defence and Civil Institute of Environmental Medicine, Toronto, 1998, p: 4.

making process on a higher level might take too much time, and the commanders at the lower echelons are not used to making their own decisions. [20]

There are two different views on Command and Control as the table below shows. Command and Control can be viewed as an attribute of Command or as a process of Control. [21]

Command and Control viewed as	
the attribute of Command (treats human as commander)	**the process of Control** (treats human as user)
Authority	Organization
Responsibility	Plans, Orders
Leadership	Doctrine, SOP's, ROE's
Trust	Procedures
Empowerment	Standards
Creativity	Software
Motivation	Equipment
Proaction	Reaction
Naturalistic decision making	Expert Systems

Command has two major functions that give it priority over Control. On one hand, Command initiates Control and provides the initial conditions to start and sustain the Control process. On the other hand, Command must be able to change existing Control structures and processes dynamically in order to meet its needs and priorities. The consequence is that the role of Control must be a flexible tool of Command. [22] Therefore, all Control structures and processes must be developed

[20] Ibid, p: 11.
[21] Carol McCann and Ross Pigeau, "Putting 'Command' back into Command and Control: the human perspective", Defence and Civil Institute of Environmental Medicine, Toronto, 1998, p: 10.
[22] Ibid, p: 11.

and implemented by Command. Control must ultimately depend on Command, which alone has the responsibility to accomplish the mission and to decide which structures and processes should be invoked.

While Control can be delegated, the responsibilities of Command always rest with the commander. The delegation of Control is an option for the commander in order to gain more time for decision-making. [23] However, many Command and Control systems primarily assist the Control process and not Command. McCann and Pigeau hypothesize, "that Control can support Command only to the extent that Control facilitates Command competency …, authority and responsibility". [24]

The availability of sophisticated Information Technology will not determine the essence of Command in war, but it will challenge leadership at all echelons. As mentioned by Martin van Creveld, "far from determining the essence of command, then, communication and information processing technology merely constitutes one part of the general environment in which Command operates." [25] Therefore, every proposed change to Control should be assessed for impacts on the three basic dimensions of Command.

Having investigated Command and Control and their interrelationship we can move forward to examine the new Control system of the Austrian Army, HEROS, using the decision tree offered by McCann and Pigeau. First a short summary of some key facts concerning the development of the subject system is necessary.

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[23] Carol McCann and Ross Pigeau, "Clarifying the concepts of Control and Command", Defence and Civil Institute of Environmental Medicine, Toronto, 1999, p: 11.
[24] Ibid, p: 12.
[25] Martin van Creveld, Command in War, p. 275.

HEROS A NEW TOOL OF COMMAND AT THE OPERATIONAL AND TACTICAL LEVELS

In 1997 the Austrian Armed Forces decided to implement a battalion-and-above Command Information System as a part of its *Fuehrungsinformations-system/Oesterreichisches Bundesheer*. For various reasons (similar requirements, interoperability, common language, etc) the intent was to develop and purchase an appropriate system in close co-operation with the German and Swiss Armed Forces. The main objectives to be met by the new system are to improve

- the shared situational awareness,
- the shared knowledge of the commander's intent, and
- the speed of command at tactical and operational levels. [26]

As a result of this development, different prototypes of HEROS, based on the Microsoft Windows NT operating system, were tested by the Austrian Army, both at the operational level, and at different tactical echelons in 1999 and again in 2000. The author participated in the planning and assessment process of both test series.

While the German Army first intended to implement HEROS at the brigade level and above, and the *Gefechtsfuehrungssystem* beneath the brigade level, the Swiss and the Austrian Army preferred a common system for all echelons. Early this year a new decision was made by the co-ordination group that a further

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[26] E-mail from ObstdG Baeck, BMLV/MilStrat, Austrian Armed Forces, 26 Sep 01, p: 1, copy available from author.

development based on HEROS should cover all echelons at the tactical and operational level. [27]

The units of the peacetime organization of the Austrian Armed Forces were planned to be fully equipped in 2003, but due to the new decision mentioned in the previous paragraph, the expectation is that the completion will slip to 2004 - 07. [28]

This new decision enables the Austrian Army to assess the subject system based on the results of the test series pertaining to the effects on the basic dimensions of Command, in order to enhance further development. It will also ensure that the system will be responsive to human needs.

Having examined the interrelationship of Command and Control and some key facts concerning the development of HEROS, we will now investigate the impact of the subject system on the basic dimensions of Command following the decision tree offered by McCann and Pigeau.

THE IMPACT OF HEROS ON THE BASIC DIMENSIONS OF COMMAND

As mentioned above, the role of Information Technology as part of C^2 systems, particularly at the operational level, is to assist the needs of the commander and his staff in allocating and managing forces to execute assigned missions. The objective of a C^2 system is to ensure the success of the military

[27] E-mail from ObstdG Baeck, BMLV/MilStrat, Austrian Armed Forces, 26 Sep 01, p: 1, copy available from author.
[28] Interviews: Divr Hochauer, BMLV/GStbGrpB, 20 Sep 01 and ObstdG Baeck, BMLV/ITPlan, 02 Oct 01, Austrian Armed Forces.

mission, by enabling a force to function more effectively and more quickly than its enemy. [29] Therefore, every change of Control structures and/or processes (Control systems) has to be assessed for effects on the three dimensions of Command as defined by McCann and Pigeau – competency, authority and responsibility. But how, specifically, can HEROS support military operations, and what are the impacts of Information Technology on decision makers at the operational level?

McCann and Pigeau offer a new approach on how to assess the value of new Control structures and processes to Command. They have developed a decision tree, which will be used in the following section to analyse the impacts of HEROS on the fundamentals of Command. [30]

IMPACT ON WILL, CREATIVITY AND MISSION

As a first step in the process the impact of HEROS on the basic elements of will, creativity and mission will be examined. The investigation of the following questions will offer considerable assistance in guiding the evaluation of Control systems.

RESTRICTION OF HUMAN WILL

Human will depends on the freedom to act. "It is the result of endorsing a climate of prudent risk taking, one where individuals are allowed to tap inherent

[29] Raymond C. Bjorklund, The dollars and sense of Command and Control, Washington: National Defence UP, 1995, p.55

[30] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, unpublished paper, copy available from author.

values, beliefs and motivations … to marshal their considerable talents towards achieving common goals." [31]

Both test series conducted by the Austrian Armed Forces determined that HEROS facilitates and speeds up the imagery of both friendly and enemy situations and improves the situational awareness of commanders at all levels. Therefore, it offers additional opportunities for decentralization in terms of delegating specific Control procedures to subordinate echelons. During the second test series it was recognized that, in particular, the synchronization of adjacent units and co-ordination of fire and movement could be delegated to lower levels. Various advantages of the tremendously increased situational awareness were noticed, in terms of almost real time friendly situation imagery, especially in reconnaissance operations, offensive and delaying operations and rearward passage of lines. There was a significantly decreased demand for co-ordination by superior commanders and a higher degree of self-synchronisation of subordinate units. It was recognized that the availability of such a Control system may reinforce the principle of *Auftragstaktik* [32], which is the Command philosophy of the Austrian Armed Forces, by enlarging the freedom of action of subordinate commanders. Using the potential of decentralizing Command in terms of more emphasis on *Auftragstaktik*, the will for prudent risk taking behaviour and initiative of commanders at the tactical level was reinforced automatically. [33]

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[31] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, unpublished paper, p. 3, copy available from author.
[32] Mission Command.
[33] Interview: ObstdG Baeck, BMLV/MilStrat, Austrian Armed Forces, 26 Sep 01.

Initiative in terms of *being first to take action* must be based on a solid situational awareness containing knowledge of the situation of the enemy, disposition and tasks of friendly forces, and how one's own mission relates to one's superior's plan. Initiative taken by commanders without available comprehension of the relevant situation can produce chaos and disastrous results. [34] As mentioned above, HEROS provides commanders with increased situational awareness, which encourages them to take more initiative, especially at the tactical level. The will of superior commanders to delegate decisions to the lowest possible level provided them with more time available for decision-making and reflection, especially at the operational level. Van Creveld noted that history has shown that "armies have been most successful which did not turn their troops into automatons, did not attempt to control everything from the top, and allowed subordinate commanders considerable latitude." [35]

On the other hand it was recognized that the same system can enhance the multiple overlays of Control at all echelons because of the increased situational awareness and the new speed of Command. The senior commander is now, as a result of the sharing of data bases and the rapid flow of information, more intimately in tune with the situation at lower levels. During the second test series the time difference of the situational awareness between the battalion and the corps level was about 50 percent less than it had been without the availability of the subject Control system. Having this in mind, some of the involved commanders,

[34] As experienced by th

especially at the operational level, tried to increase their influence on subordinate levels to avoid mistakes and failure and at least offered friendly advice. [36] The test series determined that HEROS itself is neutral in terms of supporting a special type of organization. The role of the system is to support the tradition of *Auftragstaktik* of the Austrian Armed Forces and changes of the basic philosophy due to the availability of a new tool should not be accepted. It was recognized that there is a need for preliminary training for both staff personnel and commanders, in order to provide them advice on how to use the system to delegate decision making to the lowest possible level.

The maintenance of HEROS needs only a few additional, specifically trained, communications personnel within the S 6, G 6 or J 6 divisions at all echelons involved so that the main staff functions and the commander himself are not compromised in terms of diverting their effort from the primary objective.

Fatigue or boredom while watching the screens by key personnel can be avoided due to the fact that the system is driven by operators and not by commanders or key staff personnel. The energy expended to support the Control system seems to be appropriate.[37]

Based on the results of the test series it can be concluded that HEROS is neutral to human will. However, there is a demand for preliminary training both of

[36] Interview: Divr Hochauer, BMLV/GStbGrpB, Austrian Armed Forces, 20 Sep 01.
[37] Interview: Bgdr Mather, BMLV/ITPlan, Austrian Armed Forces, 27 Sep 01.

staff personnel and commanders in order to use the new Control system to enhance *Auftragstaktik* as our Command philosophy.

RESTRICTION OF CREATIVITY

Creativity is a key characteristic of Command and enables commanders to reflect critically and to create, initiate or change Control systems. [38] Losing this capability, commanders could be condemned to applying only well known, but old solutions to present problems. Therefore, according to McCann and Pigeau, Control systems must be assessed for their ability to facilitate or at least not hinder the creativity of Command. In this section we will look at how HEROS performed in this regard.

At the beginning of the first test series some of the commanders spent too much time monitoring the system and some of them developed a narrow view. The consequence was an emphasis on reactive behaviour and a significantly lower level of personal creativity. Therefore, the fear that commanders may become slaves to technology became a real concern. During the second test series commanders became both more familiar with the system, and experienced on how to use it, to support a high level of creativity, exploratory and risk taking behaviour. [39]

[38] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, unpublished paper, copy available from author.
[39] Interview: Divr Hochauer, BMLV/GStbGrpB, Austrian Armed Forces, 20 Sep 01.

Most of the staff personnel involved, especially at the operational level, found that HEROS supported the development of courses of action by providing imagery of different maps with additional information like available infrastructure, type of terrain, movement information, logistic information, friendly and enemy situations on a continuous basis. [40] These capabilities facilitated fast imagery for courses of action of both of friendly and enemy forces including constraints, restraints, and time estimations which enabled the staff to provide the commanding general with the necessary facts within a short period of time. The tremendously increased situational awareness provided the operational level with more time for consideration especially for short term planning.

Based on test results it can be concluded that at the operational level HEROS primarily facilitates the creativity of the staff. However, it was recognized again that there is a need for preparatory training focusing on this issue.

OBSCURATION OF MISSION OBJECTIVES

During the preparations for the test series two main questions arose: 1) Does the Control system overshadow the needs of the mission for which it was developed and therefore devalue the importance of the mission because of the requirements for constant attention and nurturing? 2) Does the system become an end in itself? [41]

[40] Interview: Bgdr Mather, BMLV/ITPlan, Austrian Armed Forces, 27 Sep 01.

[41] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, p: 4, unpublished paper, copy available from author.

As mentioned earlier, it was recognized that at the beginning of the test series commanders spent too much time monitoring the system and some of them showed symptoms of hypervigilance in terms of controlling the operators and continually influencing the data update process. These commanders lost too much time for reflection and decision making which had negative impacts on their own mission. As a result we recognized a demand of preliminary training of the commanders to focus on leadership and not on the Control system.

Reviewing the test process it was discovered that HEROS allows military personnel not to define their position in the hierarchy by the role they play in maintaining the Control system. Most of the commanders involved found that it does not demand too much human resources investment to run the system on a continuous basis. The number of operators could even be reduced by 20 percent during the second test series. Therefore, the requirements for constant attention and nurturing were not too high. [42]

Based on the test results it can be concluded that HEROS has a minor negative impact on mission objectives, which can be compensated by preliminary training and education of the commanders. Therefore, there is no concern that the system could devalue the importance of assigned tasks seriously.

[42] Interview: ObstdG Baeck, BMLV/MilStrat, Austrian Armed Forces, 02 10 01.

Having examined the impact on will, creativity, and mission, in the following section, the impact of HEROS on the basic dimensions of Command will be discussed next.

IMPACT ON THE THREE DIMENSIONS OF COMMAND

The three dimensions of Command, as discussed previously, provide an appropriate framework to evaluate the effects of a Control system on Command. "… it is important to realize that although all three evaluations [of the dimensions of Command] must be performed, the order in which they are performed will depend on the type of Control system being evaluated."[43] The first step determines what the main dimension to be supported by the subject system is. If the Control system does not support the main dimension, the rest of the examination is obsolete, because the value of the system comes into question. If the system improves the desired dimension, it is then probably sufficient that the system at least does not negatively impact the other dimensions of Command.

HEROS as an information processing system was designed to support the capabilities for visualizing, reasoning, planning, and decision making at the operational and tactical levels. Therefore, as a first priority, it is designed to support intellectual competency.

Having this in mind, the next step is to examine how the system could affect the three dimensions of Command, beginning with the competency module.

[43] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, p: 5, unpublished paper, copy available from author.

THE COMPETENCY MODULE

HEROS is designed to support decision making and reasoning by providing all involved levels with visualization of the friendly and enemy situation and the necessary data flow in order to increase the situational awareness. Therefore, its primary purpose is to support *intellectual competency*.

The system can increase the speed of Command and therefore the chance to get inside the enemy's decision loop, which is a decisive point. In the test series it was recognized through various tactical situations that the group supported by HEROS, for the most part gained superiority over the adversary**.**

Professor Mackubin Owens points out that "possessing a mass of data does not mean that the decision maker understands their significance or what to do with them." [44] Human cognition is limited in its ability to process all the necessary data within a short time. The first test series highlighted that, especially at the operational level, information overload and hypervigilance occurred resulting in some cases the paralysis of key staff personnel. Under such conditions the increasing input led to decreasing critical output and thus unprocessed information became a threat in itself. [45] Commanders must be provided with selected and assessed information updates in appropriate time without involving them in the permanent data update process. It was recognized that only when data is being converted into knowledge can increased situational awareness be achieved. There

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[44] M.T.Owens, "Technology, the RMA, and Future war", *Strategic Review*, 26-2, 1998, p. 69.
[45] Interview: Bgdr Mather, BMLV/ITPlan, Austrian Armed Forces, 27 Sep 01.

is an additional demand to improve, on one hand, the software-based filters of HEROS and, on the other hand, the training of the staff to select quickly information relevant to the situation. Therefore, the different requirements for information at the operational and tactical echelons have to be assessed in order to facilitate the improvement of software-based filters. Furthermore, data has to be considered before it is reported to higher echelons.

A partial solution to information overload at the operational level could also be the reinforcement of decentralized decision making at tactical echelons as mentioned earlier. [46] However, during the second test series commanders and staff personnel became more experienced and learned to filter the information provided by HEROS. According to US Army Lieutenant General Kennedy, "Command is still largely a function of a commander's intuition … individuals perceive information in different ways. " [47]

On the other hand, as mentioned previously, it was recognized that the availability of Information Technology may result in a higher degree of centralized Control. Due to the tremendous increased situational awareness at the operational level, a higher tendency to micromanagement by the highest ranks was observed, especially during the first test series. In reality, those commanders lost a lot of time for reflection and decision making at their own level, thereby losing an important benefit of such a Control system. As suggested by Marshal Saxe, "… on the day of

[46] John D. Blair and Carlton J. Whitehead, "Developing Long-Term Adaptability and Innovativeness in the US Army", Leadership on the Future Battlefield, p. 253.
[47] McCann and Pigeau, "Clarifying the Concepts of Control and Command", Proceedings of the 1999 Command and Control Research and Technology Symposium, Washington D.C, Dept.of

the battle … the general should do nothing. He will then see better what needs doing, he will preserve his power of judgement." [48]

During both test series the system went down several times for technical reasons, highlighting the vulnerability of a centralized Command and Control system. In all these cases the system collapsed totally. Without the availability of HEROS it took approximately eight hours to determine the friendly and the enemy situation at the operational level. While most of the commanders of the Army continued to accomplish their missions based on the knowledge of their superior's intent and familiarity with the principles of *Auftragstaktik*, the Air Force faced a lot of problems due to their centralized Command system and limited flexibility. Within a few minutes the degree of uncertainty increased remarkably, especially at the operational level.

Centralized systems can only operate to the extent that the organization is intact and the communication links between the echelons remain open. [49] However, in a high intensity hostile environment we would face many vulnerabilities of the subject system due to various threats (for example: the enemy would try to jam or destroy our communications system and/or to get into it). Due to the limited capabilities of the Austrian Armed Forces the interruption of essential communications could not be prevented.

Defence, p. 8.

[48] Marshal Saxe, "The art of War" in Vice-Admiral Sir Herbert W. Richmond, Command and Discipline, London, Edward Stanford Ldt, 1927, p: 17.

[49] Henry L. Tosi, Jr.,"Why Leadership isn't enough", Leadership on the Future Battlefield, p. 128.

We must be able to continue accomplishing our mission even if the Control and communications system is not fully available. Therefore, a need for further improvement of HEROS was recognized in terms of the ability to lose some of its capabilities without collapsing fully. On the other hand we have to maintain the flexibility of commanders to take decisive action on their own and in accordance with the superior commander's intent due to our Command philosophy of *Auftragstaktik*.

There is a need to encourage commanders to use HEROS as a tool to gain maximum benefit out of its newly offered abilities. In summary the system encouraged exploratory behaviour of commanders at all echelons.

During the test series there was no noticeable impact on social support, detachment or isolation of the involved personnel, social environment, or human physiology. The subject system neither improves nor hinders *emotional* and *physical competency.* It is therefore assessed as neutral.

As mentioned earlier, it was recognized that at the beginning of the test series commanders and key staff personnel, especially at the tactical level, spent too much time monitoring the system. As a result the visibility of these commanders on the forward battlefield decreased rapidly. "Social interaction is … the primary means for developing trust, confidence and task specific interdependencies among group members. Without the benefit of social interdependencies, deep feelings of trust

and commitment are difficult, if not impossible, to attain. "[50] It showed the danger of a system which keeps tactical commanders in their headquarters. This negative impact on *interpersonal competency* can be compensated by preliminary training of both commanders and staff. Commanders still have to focus on leadership and not on the Control system.

To summarize, while HEROS primarily supports *intellectual competency,* it has minor negative impacts on *interpersonal competency.* It neither enhances nor hinders *emotional competency* and *physical competency.*

THE AUTHORITY MODULE

As already mentioned previously, HEROS is designed to support primarily intellectual competency. Therefore, authority is of secondary concern to the system.

Based on the test results it can be concluded that there are no influences by HEROS on the *legal authority* of commanders at any involved echelon.

The increased level of situational awareness, the shared knowledge of the commander's intent, and the higher speed of Command enhance the probability of success in various operations and bolster the reputation while increasing the degree of *personal authority* of the commander. Therefore, HEROS has the potential to support this dimension of Command.

[50] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, p: 13, unpublished paper, copy available from author.

There are no relevant changes to either the organizational structures or the basic education and training system of commanders, and the majority of the staff both at the tactical and operational level. The system does not demand additional paperwork or bureaucracy and requires only a few minor regulations.

HEROS itself has neither authority nor capabilities to take any action on its own. Finally there are no impacts by the system to the degree to which superiors could abuse their authority.

Therefore, the system has the potential to produce a minor positive effect on *personal authority* while being neutral to *legal authority*.

THE RESPONSIBILITY MODULE

As mentioned in a previous section, the dimension of responsibility is also of secondary concern to the system. Therefore, we will examine whether the system at least does not discourage the acceptance of extrinsic responsibility, or the investment of intrinsic responsibility.

As mentioned previously, some commanders relied too much on HEROS. As a result of this, one of them blamed the system when things did not turn out as planned. We recognized again a requirement for a preliminary training of the commanders to focus on leadership and not on the system. However, it can be concluded that HEROS does not affect the clarity and explicitness of the accountability expected by external authorities, which is important at the operational level. There was no major impact on the willingness of the

commanders to be held accountable for given authority identified. Therefore, one can conclude that HEROS is neutral to *extrinsic responsibility*.

The struggle between the need for Control and creative Command was examined earlier. An extensive degree of Control hinders creativity, while not enough Control promotes chaos. [51] In the second test series a well balanced level of risk taking behaviour and intrinsic responsibility was experienced. There were no cases of inappropriate risk taking behaviour. The increased situational awareness enhanced the degree to which the commanders perceived both the current friendly and enemy situation. During the second test series some commanders found that the system reinforced the degree of responsibility for subordinate units in terms of normative commitment, which caused in some cases, an increased tendency to micromanagement, as mentioned earlier. It was again recognized that, in terms of reinforcement of decentralization, HEROS created a double-edged sword that commanders will need to wield carefully.

Accordingly it can be stated that HEROS is neutral to *extrinsic responsibility* and *intrinsic responsibility*.

[51] McCann and Pigeau, "Assessing the Influence on Command of Control structures and Processes," 2001, p: 15, unpublished paper, copy available from author.

Summary

Having examined the impact of HEROS on the basic dimensions of Command, all the influences can be summarized in the following table:

Dimension	Potential Impact	Remarks
Human Will	Neutral	Requires preliminary training for commanders and staff to use HEROS to reinforce *Auftragstaktik*.
Creativity	Positive	Requires additional training for staff to enhance the ability to develop courses of action using the advantages provided by HEROS.
Mission Objective	Negative	Requires training of commanders to focus on leadership and not on the system.
Intellectual Competency (main dimension)	Positive	System requires improvement in terms of • information selection (software-based filters) and • the ability to lose some of its capabilities without collapsing fully. Need for assessment of the different requirements for information at the operational and tactical echelons. Need for training of staff in terms of the ability to select quickly relevant information and to convert data into knowledge. Requires training of commanders at the operational level and at higher tactical echelons to focus on knowledge and to reject unprocessed data.
Interpersonal Competency	Negative	Requirement to train commanders at tactical level to focus on leadership and not on the system in order to maintain their presence on the forward battlefield.
Emotional Competency	Neutral	
Physical Competency	Neutral	
Personal Authority	Positive	
Legal Authority	Neutral	
Intrinsic Responsibility	Neutral	
Extrinsic Responsibility	Neutral	Requires training of commanders to focus on leadership and not on the system.

It was recognized that HEROS can only operate to the extent that the system is fully intact and the communication links between the echelons remain open. This resulted in a demand for further improvement of HEROS in terms of being able to lose some of its capability without collapsing fully. Furthermore there is a need for improvement of the software-based filters, based on a new assessment of the different requirements for information at the operational and tactical echelons, in order to facilitate the selection of relevant information especially at the operational level.

CONCLUSION

The enormous advances in Information Technology over recent decades represent a significant milestone in the development of Command and Control. While advances in Information Technology are mostly driven by commercial developments rather than by classified military research, some of the available Control systems assist to a certain degree the Control process, but not necessarily the commander. Therefore, new Control systems should be examined prior to their implementation for their impact on the basic dimensions of Command.

This paper has argued that modern Control systems like HEROS support only some of the basic dimensions of Command in war, are neutral to many others and can even have negative impacts on some of the dimensions.

Based on the decision tree offered by McCann and Pigeau and using an analysis of the test results it was determined that HEROS supports intellectual competency as its primary dimension to a high degree, it has also some positive

impacts on creativity and personal authority. The system is neutral to human will, emotional competency, physical competency, legal authority, intrinsic responsibility and extrinsic responsibility. Finally there are minor negative effects on mission objective and interpersonal competency, which can be compensated by appropriate training of both commanders and staff.

The examination showed that there is a requirement for further improvement of HEROS. It was recognized that the implementation of the Control system requires preliminary training both of commanders and staffs.

Despite the advances of new Information Technology, Command will always remain the primary element of Command and Control and therefore success will continue to depend primarily on a commander's creativity and intuition. Having this in mind it can be concluded that the availability of highly sophisticated Information Technology will not determine the essence of Command in war, but it will challenge the leadership at the operational level. The commanding general must know how to use available Control systems in a manner that contributes to his ability to influence the conduct of the operation and he must always examine his Control organization to ensure that it reflects his requirements.

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